

REMARKS

Applicant acknowledges with thanks the examiner's indication that claims 30-32 would be allowable if re-written in independent form to include all the limitations of the base and intervening claims.

The examiner rejected claims 1-29 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,879,709 to Tian et al.

Specifically, with respect to independent claim 1, the examiner stated:

As indicated by Tian, it is a prior art (column 12, lines 18-20) that one of the ordinary skill in the art can compute transformation parameters (compute the location of the **salient** landmarks/points) (column 12, lines 18-25) that represent a transformation from the deformable model to the positions (variability/change of shape properties of pose/expression model) (column 9, line 65 to column 10, line 14) of the four points (FIG. 5B; FIG 9, element 905; and column 12, lines 18-25). Thus it would have been obvious for one of the ordinary skill in the art to modify Tian's method in estimating position to compute transformation parameters of deformable model to the positions of the four points to better determine facial expression because characteristic points able to normalize and maintain visual appearance of a human face (column 12, lines 40-55). This would improve processing and therefore, it would have been obvious to one of ordinary skill in the art to modify Tian to implement the discussed limitation. (Emphasis in the original, Final Action, pages 3-4)

Applicant respectfully disagrees.

Applicant's independent claim 1 recites “[a] medium bearing a deformable model configured to enable a machine to estimate positions of four points defined by X and Y coordinates, each of the points representing a facial element position in a digital image, and compute transformation parameters that represent a transformation from the deformable model to the positions of the four points.”

Tian describes detection, recognition and facial expression classification of the appearance of human faces in digital images and video (col. 1, lines 10-12.) With respect to the prior art face characteristic point detector alluded to by the examiner, Tian explains:

Continuing with FIG. 5B where is shown a prior art face characteristic point (landmark) detector. This is a computer system 555 that takes as input 550, which is the output (540 and 545) of the face detector system

described in FIG. 5A. When there is a face present in image/video 510, which is indicated to system 555 by a non NIL value of input 550, a prior art characteristic point detector 560 computes the locations of salient landmarks (points). These points are output 565 as a list of image locations and are expressed in terms of image/frame 569 coordinates. The characteristic points include as a first set the inner point of the right eyebrow P.sub.1 570 and the inner point of the left eyebrow P.sub.2 575. As a second set of characteristic points, we have the center of the pupil of the right eye P.sub.3 580 and the center of the pupil of the left eye P.sub.4 585. A final set is the right corner of the mouth P<sub>5</sub> 590 and the left corner of the mouth P.sub.6 595. (Here left and right is defined with respect to the person whose face is imaged.)

Further, a window 599 is selected such that it encloses the face image with certain tolerances. This window 599 is associated with a face coordinate system x, y 501. (FIG. 5B, and col. 12, lines 18-39)

Thus, the prior art detector described by Tian computes positions of points on face images. The prior art face detector does not compute transformation parameters representing a transformation from a deformable model to positions of points in a face image.

The examiner also relies on FIG. 9 to support the rejection of claim 1. With respect to FIG. 9, Tian states:

**FIG. 9 describes in more detail the process by which the facial features are computed. The facial features that are computed by this process are the preferred features of this invention. Input to the system are face sub-image 700 with zones 651, 653, 657, 658 and 659. This sub-image is of size K 648 rows and L 646 columns. Also input to the system are the characteristic points P<sub>1</sub>, P<sub>2</sub>, P<sub>3</sub>, P<sub>4</sub>, P<sub>5</sub> and P<sub>6</sub> 905. The characteristic points include as a first set the inner point of the right eyebrow P<sub>1</sub> 570 and the inner point of the left eyebrow P<sub>2</sub> 575. As a second set of the characteristic points, we have the center of the pupil of the right eye P<sub>3</sub> 580 and the center of the pupil of the left eye P<sub>4</sub> 585. A final set is the right corner of the mouth P<sub>5</sub> 590 and the left corner of the mouth P<sub>6</sub> 595.**

**Step 910 in process 900 determines distances (lengths) L<sub>1</sub> 711, L<sub>2</sub> 712, L<sub>3</sub> 713, L<sub>4</sub> 714 and L<sub>5</sub> 715. First the line 701 that connects the center of the pupil of the right eye P.sub.3 580 and the center of the pupil of the left eye P<sub>4</sub> 585 is determined. Distance L<sub>1</sub> 711 is the distance between line 701 and the left corner of the mouth P<sub>6</sub> 595. Distance L<sub>2</sub> 712 is the distance between line 701 and the right corner of the mouth P<sub>5</sub> 590. Distance L<sub>3</sub> 712 is the distance between the inner point of the right eyebrow P<sub>1</sub> 570 and the inner point of the left eyebrow P<sub>2</sub> 575. Distance L<sub>4</sub> 714 is the height of the left eye and is determined by any of ellipse fitting to eye edges, determining the moments of the eye edges, determining the variance of the eye edges in the vertical direction. Similarly, distance L<sub>5</sub> 715 is the height of the right eye.**

**Other methods for determining the height of the eyes are within the realm of this invention.**

**Step 920 in process 900 determines distances (lengths)  $L_6$  732 and  $L_7$  733. Distance  $L_6$  is computed as the distance between line 701 and point  $P_2$  570. Equivalently, distance  $L_7$  is computed as the distance between line 701 and point  $P_1$  575.**

**Step 930 of process 900 computes the three edge histograms  $H_1$ ,  $H_2$ ,  $H_3$  by processing the edges in zones 657, 658 and 659, respectively. This processing is achieved as explained in FIG. 7C. The mouth shape can be represented using many shape features. Shape histograms of the mouth, or portions of the mouth, is one way of representing shape. Other facial features that represent shape and distance for expression analysis are obvious to those skilled in the art after reading this invention.**

**Finally, step 940 of process 900 outputs the face features  $f_1$ ,  $f_2$ ,  $f_3$ , . . . as they are determined from the distances  $L_i$  and histograms  $H_j$  or other shape representations/features. (FIG. 9, and col. 14, line 54 to col. 15, line 34)**

Tian's system computes facial features in a face image, including distances (e.g.,  $L_1$ ,  $L_2$ , etc.) from characteristic points. Tian's system, however, does not compute transformation parameters, and certainly does not compute, as recited in claim 1, transformation parameters representing a transformation from a deformable model to positions of points in a face image.

Accordingly, Tian fails to disclose or suggest at least the features "compute transformation parameters that represent a transformation from the deformable model to the positions of the four points," as required by applicant's independent claim 1. Applicant's independent claim 1, and the claims that depend from it, are therefore patentable over the cited art.

Independent claims 9, 18 and 27 recite "computing transformation parameters that represent a transformation from the deformable model for the frame to the subsequent deformable model of the subsequent frame," or similar language. For reasons similar to those provided with respect to independent claim 1, at least this feature is not disclosed by the cited art. Applicant's independent claims 9, 18 and 27, and the respective claims depending from them, are therefore patentable over the cited art.

Additionally, as noted, the examiner rejected claim 10, which depends from independent claim 9, as being obvious over Tian. Specifically, the examiner stated:

Referring to claim 10, Tian teaches the method wherein computing the transformation parameters (compute the location of the **salient landmark/points**) (column 12, lines 18-25) includes determining optimal values for the transformation parameters such that the value of an objective function based on the transformation parameters is minimized (eliminates complicated degree of freedom/normalization) (column 10, lines 10-14 and column 12, lines 40-55). (emphasis in the original, Final Action, page 6)

Applicant respectfully disagrees.

Claim 10 recites “wherein computing the transformation parameters includes determining optimal values for the transformation parameters such that the value of an objective function based on the transformation parameters is minimized.”

In contrast, Tian explains:

**Face recognition systems work best when both the enrolled face and the face to be authenticated have no expression. The ability to detect if a face image has no expression has, in general, many applications since it eliminates one complicated degree of freedom, the facial expression, from the face image acquisition process.** (Col. 10, lines 8-14)

Thus, in the above passage Tian merely explains that it is easier to perform face recognition for face images in which the shown faces have a neutral expression (i.e., the faces are not contorted based on emotions such as anger or happiness.)

Tian also describes:

**FIG. 6 explains how the outputs of the face detector and the characteristic point detector are used to normalize the face image to a fixed resolution and how the zones in the normalized face image are determined. Image 600 is the input image or a frame of the input video (i.e., an image 510). The input image 600 contains the appearance of a human face (face image) 605. Furthermore, it contains a smaller image or window 599 that encloses within specified tolerances the visual appearance of the human face. The window is associated with coordinate system 501. This window is selected in such a way that the important features for face expression are containing therein. We refer in the rest of this invention description to this window as the face image or face appearance image. (This face image can be at the original resolution of input image 600 or it can be at the resolution of image 620 after re-sampling, or normalization, of transform 615.) (Emphasis added, col. 12, lines 40-56)**

In this passage, Tian explains that a smaller window, selected in such a way that the window would contain important features for face expression, is used.

Thus, contrary to the examiner's contentions, nowhere does Tian describe an objective function that is minimized to determine optimal values for transformation parameters.

Accordingly, Tian also fails to disclose or suggest at least the features of "wherein computing the transformation parameters includes determining optimal values for the transformation parameters such that the value of an objective function based on the transformation parameters is minimized," as required by applicant's claim 10. Applicant's claim 10, and the claims that depend from it, are therefore patentable over the cited art.

Applicant's claim 19 (depending from independent claim 18) recites "wherein the instructions that cause the data processing apparatus to compute the transformation parameters include instructions to determine optimal values for the transformation parameters such that the value of an objective function based on the transformation parameters is minimized." For reasons similar to those provided with respect to claim 10, at least this feature is not disclosed by the cited art. Applicant's claim 19, and the claims depending from it, are therefore patentable over the cited art.

It is believed that all the rejections and/or objections raised by the examiner have been addressed.

In view of the foregoing, applicant respectfully submits that the application is in condition for allowance and such action is respectfully requested at the examiner's earliest convenience.

All of the dependent claims are patentable for at least the reasons for which the claims on which they depend are patentable.

Canceled claims, if any, have been canceled without prejudice or disclaimer.

Any circumstance in which the applicant has (a) addressed certain comments of the examiner does not mean that the applicant concedes other comments of the examiner, (b) made arguments for the patentability of some claims does not mean that there are not other good reasons for patentability of those claims and other claims, or (c) amended or canceled a claim

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does not mean that the applicant concedes any of the examiner's positions with respect to that claim or other claims.

No fee is believed due. Please apply any other required fees to deposit account 06-1050, referencing the attorney docket number shown above.

Respectfully submitted,

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